Assignment 4

Sets and Subsets; Boolean Algebra

Textbook Assignment: Chapters 6 and 7

Learning Objective:

Recognize terms and symbols concerning sets and subsets and the symbolic use of Venn diagrams.

4-1. Which notation is an example of a set builder notation?
1. A, B, C, · · ·
2. {r, s, t, u, n, w}
3. {y|y is divisible by 5}
4. "The set of numbers between two and ten"

4-2. If set B = {-3, 0, 3, 6, · · ·}, which of the following is true concerning the elements of B?
1. $3 \notin B$
2. $4 \in B$
3. $9 \in B$
4. $8 \in B$

4-3. Which statement correctly matches finite or infinite with the given set?
1. If set R = {5, 10, 15, 20, · · ·}, then set R is finite.
2. If set M = {x|x is a plant on earth}, then set M is finite.
3. If set D = {x|x is an even integer}, then set D is finite.
4. If set B = {the days in a year}, then set B is infinite.

4-4. Which of the following two sets are equal?
1. A = {a, b, c}, B = {b, c, d}
2. A = {4, 8, 6, 6}, B = {4, 8, 6}
3. A = {5, 4, 6, 3}, B = {5, 3, 7, 4}
4. A = $\{x|x^2 - 5x = -4\}$, B = {2, 3}

4-5. The set B = $\{x|x^2 = 16$, x is even$\}$ is an example of a null set.

4-6. If set A = {4, 6, 8, 10, 12}, which of the following values of B is a subset of A?
1. B = {8}
2. B = {7, 9}
3. B = {6, 7, 8}
4. B = {10, 12, 14}

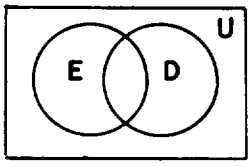
4-7. Which of the following pair of sets is comparable?
1. A = {7, 8, 9}, B = {6, 7, 8}
2. A = {3, 5, 7}, B = {5, 6}
3. A = {4, 5, 6}, B = {5}
4. A = {6, 9}, B = {8, 7}

4-8. Which of the following represents a universal set?
1. The natural numbers
2. The Greek alphabet
3. The animals of the earth
4. All of the above

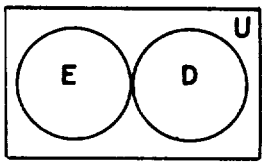
4-9. If set A = {1, 2, 3, 4, 5}, how many subsets does A contain?
1. 32
2. 16
3. 8
4. 5

4-10. Which of the following pairs of sets are disjoint?
1. A = {a, b, c}, B = {r, s, t}
2. A = {b, e, g}, B = {d, e, f}
3. A = {3, 4, 5}, B = {5, 6, 7}
4. A = {3, 6, 9}, B = {4, 6, 8}

4-11. Which Venn-Euler diagram represents D $\subset$ E?



1.



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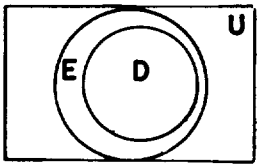

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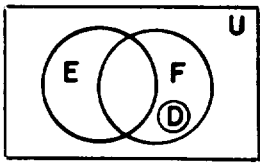


4.

Learning Objective:

Perform the operations of union, intersection, difference, and complement on sets.

4-12. If set A = {2, 4, 5, 6, 8} and set B = {3, 6, 9}, what is $A \cup B$?
1. {3, 6, 9}
2. {2, 4, 5, 8}
3. {2, 3, 5, 6, 8, 9}
4. {2, 3, 4, 5, 6, 8, 9}

4-13. If set A = {1, 3, 5, 6, 7}, and set B = {3, 4, 5, 6}, what is $A \cap B$?
1. {1, 3, 4, 5, 6, 7}
2. {3, 5, 6}
3. {1, 4, 7}
4. {1, 7}

4-14. If set A = {2, 3, 4, 5} and set B = {3, 5, 7}, what is B - A?
1. {7}
2. {2, 4}
3. {2, 7}
4. {3, 5}

● Use the following information for items 4-15 through 4-18. A = {2, 4, 6}, B = {4, 5, 6}, C = {3, 5, 7}, and the universe U = {1, 2, 3, 4, 5, 6, 7, 8}.

4-15. The set $\overline{C}$ equals
1. {3, 5, 7}
2. {1, 2, 3, 6, 8}
3. {1, 2, 4, 6, 8}
4. {1, 3, 5, 7, 8}

4-16. The set $(\overline{A \cup B})$ equals
1. {1, 2, 7, 8}
2. {1, 3, 7, 8}
3. {2, 4, 5, 6}
4. {3, 4, 5, 6}

4-17. The set $(\overline{A \cap B})$ equals
1. {4, 6}
2. {1, 3, 7, 8}
3. {2, 4, 5, 6}
4. {1, 2, 3, 5, 7, 8}

4-18. The set $(\overline{A - C})$ equals
1. {1, 8}
2. {2, 4, 6}
3. {1, 2, 4, 6, 8}
4. {1, 3, 5, 7, 8}

Learning Objective:

Identify algebraic laws regarding sets.

4-19. $B \cup B$ and $B \cap U$ obey the idempotent law of sets.

4-20. Which of the following is an example of the distributive law of sets?
1. $X \cup (Y \cap Z) = (X \cup Y) \cap (X \cup Z)$
2. $(X \cap Y) \cap Z = X \cap (Y \cap Z)$
3. $(\overline{X \cap Y}) = \overline{X} \cup \overline{Y}$
4. $X \cup Y = Y \cup X$

4-21. The expression $(X \cup Y) \cup Z = X \cup (Y \cup Z)$ is an example of which law of sets?
1. Idempotent law
2. Commutative law
3. Associative law
4. Distributive law

4-22. $L \cup K = K \cup L$ obeys the commutative law.

● In items 4-23 through 4-26 select the example that represents the given law of sets.

4-23. Identity law.
1. $M \cup M = M$
2. $M \cap \emptyset = \emptyset$
3. $M \cap \overline{M} = \emptyset$
4. $M \cup \overline{M} = U$

4-24. Complement law.
1. $P \cup \overline{P} = U$
2. $P \cap P = P$
3. $P \cap U = P$
4. $P \cap \emptyset = \emptyset$

4-25. DeMorgan's law.
1. $L \cup U = U$
2. $L \cup K = K \cup L$
3. $\overline{L \cap K} = \overline{L} \cup \overline{K}$
4. $(L \cap K) \cap N = L \cap (K \cap N)$

4-26. If $(A \cap B) \cap (B \cup C) = A \cap B$, then by the principle of duality which equation is a valid theorem?
1. $(A \cap B) \cup (B \cup C) = B \cup C$
2. $(A \cup B) \cup (B \cap C) = A \cup B$
3. $(A \cap C) \cup (A \cup B) = A \cup B$
4. $(A \cup B) \cup (B \cup C) = A \cup B$

Learning Objective:

Identify classes and elements of Boolean algebra and their relationships to Venn diagrams.

4-27. Classes in binary Boolean algebra are formed only by elements having
1. no stable states
2. one stable state
3. two stable states
4. two unstable states

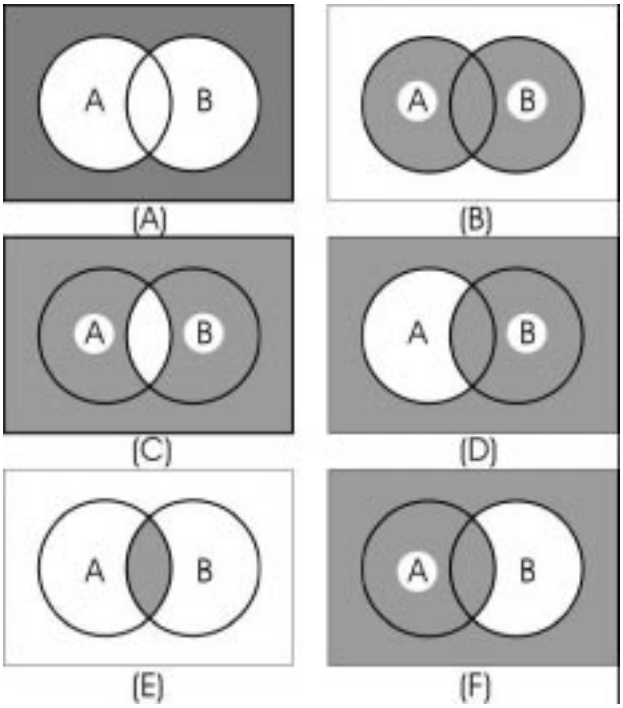


Figure 4A.--Venn diagram

● Items 4-28 through 4-34 refer to figure 4A.

4-28. The class "not A or not B" is represented by the shaded area in diagram
1. (A)
2. (C)
3. (E)
4. (F)

4-29. In what diagrams does the shaded area represent a minter-m class?
1. (A) and (E)
2. (B) and (E)
3. (A), (B), (E)
4. (B), (C), (D), and (F)

4-30. What class is represented by the unshaded area in diagram (F)?
1. A and not B
2. B and not A
3. A or not B
4. B or not A

4-31. In what diagrams does the shaded area represent a maxterm class?
1. (A) and (C)
2. (C), (D), (E)
3. (B), (C), (D), and (F)
4. (A), (C), (D), and (F)

4-32. Let A represent cruisers and B represent flagships. If the shaded area of diagram (A) represents all ships that are neither cruisers nor flagships, the universal class with respect to this diagram consists of all
1. ships
2. cruisers and flagships
3. ships and objects that are not ships
4. ships that are neither cruisers nor flagships

4-33. What class (written in Boolean algebra notation) is represented by the shaded area in diagram (D)?
1. $\overline{A}B$
2. $A + \overline{B}$
3. $A + \overline{B}$
4. $B + \overline{A}$

4-34. Classes represented by the shaded areas of which of the two diagrams are complements of each other?
1. (A) and (B)
2. (B) and (E)
3. (C) and (D)
4. (D) and (F)

Learning Objective:

Identify logic operations in relation to Venn and logic diagrams, truth tables, and switching circuits.

4-35. If A = 1 and B = 0, what is the value of f(A,B) = AB?
1. 0
2. 1
3. 10
4. 0 < f(A,B) < 1

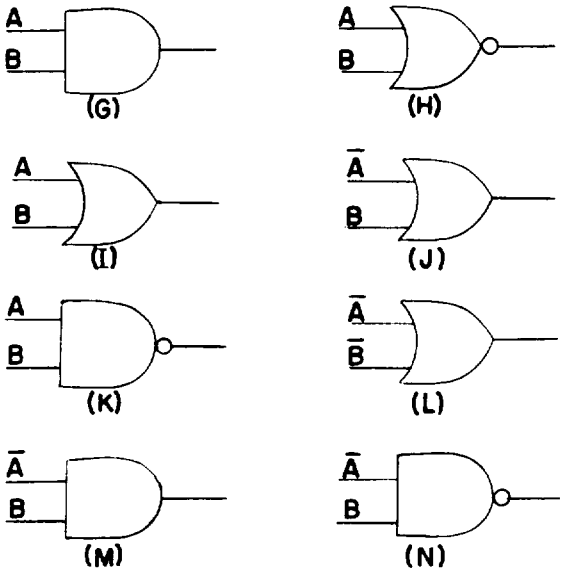
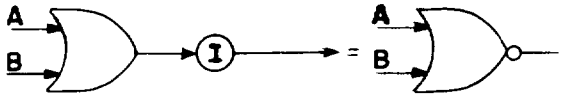
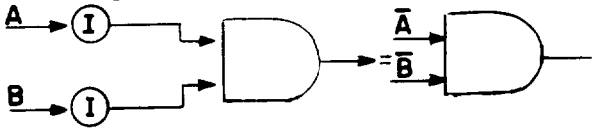


Figure 4B.--Logic Symbols.

● (Note: Notice that some of the logic symbols in your textbook differ but are equal.) For example, the logic symbol



and the logic symbol



● In items 4-36 through 4-39, select a logic symbol from figure 4B that is equivalent to the shaded area of the indicated Venn diagram in Figure 4A.

4-36. Venn diagram (C).
1. (H)
2. (I)
3. (L)
4. (N)

4-37. Venn diagram (D).
1. (J)
2. (L)
3. (M)
4. (N)

4-38. Venn diagram (A).
1. (H)
2. (K)
3. (M)
4. (N)

4-39. Venn diagram (E).
1. (G)
2. (I)
3. (K)
4. (L)

● Items 4-40 through 4-45 refer to figure 4B.

4-40. What is the Boolean algebra notation for symbol (H)?
1. $\overline{AB}$
2. $\overline{A} + \overline{B}$
3. $\overline{A + B}$
4. $A\overline{B} + \overline{A}B$

4-41. What is the Boolean algebra notation for symbol (J)?
1. $\overline{A}B$
2. $\overline{A} + B$
3. $\overline{A + B}$
4. $\overline{A}B + B$

4-42. What symbol represents $f(A,B) = \overline{A}B$?
1. (J)
2. (K)
3. (M)
4. (N)

4-43. The output of (N) is zero when the inputs are
1. A = 0, B = 0
2. A = 0, B = 1
3. A = 1, B = 0
4. A = 1, B = 1

4-44. What symbol represents a circuit that has a zero output only when the inputs are A = 1, B = 0? (This means that there is an output when A = 0, B = 1; A = 1, B = 1; and A = 0, B = 0.)
1. (H)
2. (J)
3. (M)
4. (N)

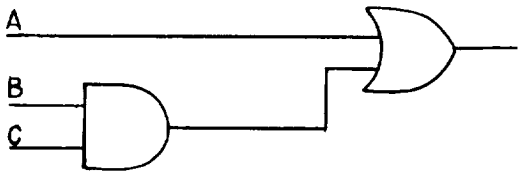
4-45. The truth tables of what two symbols are identical?
1. (H) and (L)
2. (J) and (N)
3. (K) and (L)
4. (M) and (N)

Learning Objective:

Determine the outputs of logic diagrams and the least number of gates required for a given output.

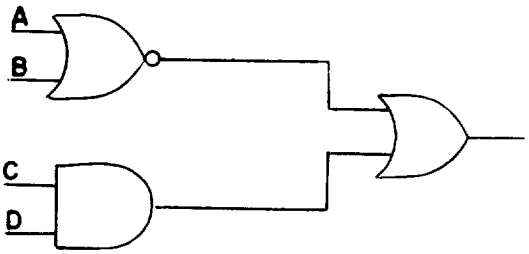
● In items 4-46 through 4-48, find the output of the indicated logic diagrams.

4-46.



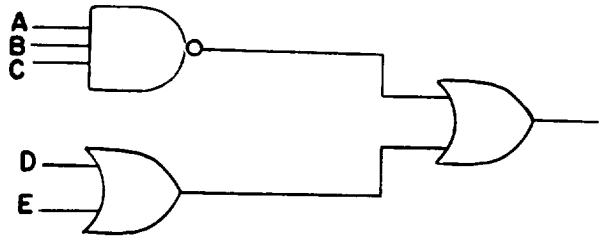
1. $A + B + C$
2. $A + BC$
3. $AB + C$
4. ABC

4-47.



1. $\overline{(A + B)}(CD)$
2. $\overline{(A + B)} + CD$
3. $\overline{(A + B)} + (C + D)$
4. $(\overline{A} + \overline{B}) + (C + D)$

4-48.



1. $\overline{(ABC)}\ (DE)$
2. $ABC + DE$
3. $\overline{ABC} + DE$
4. $\overline{ABC} + (D + E)$

● In items 4-49 and 4-50, determine how many gates are needed to construct the simplest possible logic diagram for the Boolean expression given.

4-49. $(A+B)CD$
1. 4
2. 3
3. 2
4. 1

4-50. $(A + B)C + DE$.
1. 3
2. 4
3. 5
4. 6

Learning Objective:

Identify basic laws which represent given Boolean expressions.

4-51. A series circuit consists of a battery, B; two switches, X and Y; and a lamp L. The components are connected in the order, B, X, Y, L, and the lamp lights when both switches are closed. The fact that the operation of the circuit is unchanged when the order of the components is changed to B, Y, X, L, demonstrates what basic law of Boolean algebra?
1. Associative
2. Idempotent
3. Complementary
4. Commutative

● In items 4-52 through 4-56, select the law of Boolean algebra that represents the given expression.

4-52. $C + 1 = 1$.
1. Law of union
2. Law of identity
3. Law of dualization
4. Law of intersection

4-53. $LM + \overline{LM} = 1$.
1. Commutative law
2. Complementary law
3. Law of identity
4. Law of double negation

4-54. $D + DF = D$.
1. Law of union
2. Commutative law
3. Law of absorption
4. Law of intersection

4-55. $Z + Z = Z$.
1. Idempotent law
2. Law of union
3. Law of absorption
4. Law of intersection

4-56. $(L + P)\ (L + D) = L + PD$.
1. Associative law
2. Commutative law
3. Complementary law
4. Distributive law